

Alcohol use and wages: New results from the national household survey on drug abuse

By: Gary A. Zarkin, Michael T. French, Thomas Mroz, [Jeremy W. Bray](#)

Zarkin, G. A., French, M. T., Mroz, T., & Bray, J. W. (1998). Alcohol use and wages: New results from the national household survey on drug abuse. *Journal of Health Economics*, 17(1), 57–71.

***© Elsevier. Reprinted with permission. No further reproduction is authorized without written permission from Elsevier. This version of the document is not the version of record. Figures and/or pictures may be missing from this format of the document. ***

Made available courtesy of Elsevier: [http://dx.doi.org/10.1016/S0167-6296\(97\)00023-4](http://dx.doi.org/10.1016/S0167-6296(97)00023-4).



This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](#).

Abstract:

A recent study published in the *Journal of Health Economics* by French and Zarkin [French, M.T., Zarkin, G.A., 1995. Is moderate alcohol use related to wages? Evidence from four worksites, *Journal of Health Economics* 14, 319–344] found evidence of a positive, inverse-U-shaped relationship between wages and alcohol consumption for individuals at four worksites. In this paper, we attempted to replicate French and Zarkin's findings using a combined sample of prime-age workers from the 1991 and 1992 National Household Surveys on Drug Abuse (NHSDA). Whereas French and Zarkin found that individuals who consume approximately 1.5 to 2.5 drinks per day have higher wages than non-drinkers and heavy drinkers, we found no evidence of a turning point at this consumption level for either men or women. Our results do suggest that men who use alcohol have approximately 7% higher wages than men who do not drink, and this apparent wage premium is approximately the same over a wide range of alcohol consumption. For women, the estimated alcohol use premium is approximately half as large as for men and is statistically insignificant.

Keywords: alcohol use | wages | productivity | workplace

Article:

1. Introduction

Alcohol is the nation's most used drug. The prevalence of alcohol use among the US household population age 12 years and older is estimated to be 54% in 1994, compared to 6% for illicit drug use and 29% for cigarette smoking (SAMHSA, 1995). Because of its high use and acceptability, however, light to moderate alcohol use has not commonly been viewed as a major social problem. In fact, quite the opposite may be true, as light to moderate alcohol use may provide beneficial health effects. The medical literature has identified a U-shaped relationship between alcohol consumption and the risk of coronary heart disease (CHD), in which light to

moderate drinkers have a lower risk of CHD than do either abstainers or heavy drinkers (e.g., Boffetta and Garfinkel, 1990; Doll et al., 1994).

Motivated in part by this medical relationship, French and Zarkin (1995) tested the hypothesis that light to moderate drinking was associated with higher wages. Using a sample of employees at four worksites, they found that individuals who consume approximately 1.5 to 2.5 drinks per day have significantly higher wages than abstainers and heavy drinkers. These results also hold for a subset of prime-age workers between the ages of 30 and 59.¹

The findings of French and Zarkin (1995) of an inverse-U-shaped relationship between wages and alcohol use is striking, but the study is limited by the small number of worksites in their sample. The main purpose of this paper is to evaluate whether the French and Zarkin (1995) results can be replicated on a combined sample of workers from the 1991 and 1992 National Household Surveys on Drug Abuse (NHSDA). The NHSDA are nationally representative cross-section surveys of the US non-institutionalized population age 12 and over that contain detailed information on alcohol and illicit drug use, as well as labor market information such as wages and hours worked.

In addition to evaluating the replicability of the French and Zarkin (1995) results, this paper makes two other contributions. First, we relaxed the functional form assumptions of French and Zarkin (1995) to allow a more flexible relationship between alcohol use and wages. Previously, French and Zarkin (1995) postulated that alcohol use was related to wages through quadratic and cubic functional forms. In this paper, we constructed eight indicator variables of alcohol use based on the number of drinks in the past 30 days. This specification reduces the influence of high drinking levels on the estimated wage-alcohol use relationship. Second, we estimated separate models for men and women. Past research has noted gender differences between men's and women's alcohol consumption and in alcohol-related problems (Wilsnack et al., 1994; Lex, 1994; Caetano, 1994), as well as in the relationship between alcohol consumption and labor market outcomes (Mullahy and Sindelar, 1992, 1996).

Our results suggest that alcohol use is associated with approximately 7% higher wages for men and 4% higher wages for women, although the results for women are not significantly different from zero. Although we found some evidence of an inverse-U-shaped relationship between alcohol use and wages at low drinking levels for men, we cannot reject the hypothesis of a constant 7% wage premium over the range of alcohol consumption observed in the data. We also found no evidence of a non-linear relationship between alcohol consumption and wages for women. Based on these results, in conjunction with the results of French and Zarkin (1995) and

¹ The general result obtained by French and Zarkin (1995) that alcohol users have higher wages than non-users supports the results of Berger and Leigh (1988) and Heien (1996). There is also a literature that examines the relationship between problem drinking, usually defined as heavy drinking or alcoholism, and labor market outcomes. For example, Mullahy and Sindelar (1991) found that alcoholism was associated with lower income for males (negative but insignificant for women), Mullahy and Sindelar (1993) also find a substantial negative relationship between alcoholism and income, and the effect is larger in absolute value for individuals between the ages of 30 and 59. Mullahy and Sindelar (1996) found that problem drinking, as defined using the DSM-III-R classification system, reduces employment and increases unemployment. We refer the reader to Mullahy and Sindelar (1996) and French and Zarkin (1995) for a more extensive description of these and related papers (e.g., Benham and Benham, 1992; Kenkel and Ribar, 1994).

others, we conclude that there is strong evidence of a positive relationship between wages and alcohol use for men but substantially weaker evidence of such a relationship for women.

2. Data and sample

We used data from the 1991 and 1992 NHSDA public use files to model the relationship between alcohol use and wages among prime-age workers (i.e., age 30 to 54). Both the 1991 and 1992 NHSDA provide nationally representative data on the substance use of the non-institutionalized US household population age 12 and older (SAMHSA, 1992, 1994). The NHSDA instrument collects data on the prevalence of current and lifetime use of tobacco, alcohol, and illicit drugs, as well as basic demographic and employment data. Because of the sensitive nature of the survey topic, self-administered answer sheets are used for the substance use questions to increase the confidentiality and anonymity of the respondent's answers. This format is designed to minimize underreporting of substance use, which is a potential limitation of self-reported surveys (Hoyt and Chaloupka, 1994). In a 1990 field test of various survey instruments, Turner et al. (1992) found that the self-administered format of the NHSDA decreases the underreporting of substance use compared to an interviewer-administered format.

In both 1991 and 1992, the NHSDA used a five-stage area probability sample design (SAMHSA, 1992, 1994). In all analyses, we used NHSDA sampling weights that were based on the probability of selection at each stage². In addition, the observations in the NHSDA are clustered within primary sampling units. Intraclass correlation represents a specific form of error correlation that violates standard independence assumptions. Therefore, we implemented a White/Huber standard error correction (Huber, 1967; White, 1980; StataCorp, 1995) in our analyses to account for the effects of clustered data.

In this paper, we focused on prime-age workers. Consequently, our sample consisted of all respondents between the ages of 30 and 54 who were not on active military duty, not enrolled in school, reported positive wages, and had non-missing values for all variables used in our analyses. Although French and Zarkin (1995) defined prime-age workers as those individuals aged 30 to 59, we define prime-age workers as those aged 30 to 54. Our upper age limit is 5 years younger than that of French and Zarkin (1995) to ensure that we did not include individuals who may have entered partial retirement at age 55. The final sample sizes used in our analyses are 3015 men and 3176 women in 1991, and 2933 men and 2991 women in 1992, for a total combined sample of 5948 men and 6177 women.

Because men and women differ substantially in their labor market behavior and alcohol consumption (Wilsnack et al., 1984; Wilsnack and Wilsnack, 1992; Ferrence, 1980; Mullahy and Sindelar, 1992, 1996), we conducted all of our analyses separately for men and women. Table 1 presents the weighted means and standard deviations of our analysis variables for both men and women. We present statistics for our combined sample and separately for 1991 and 1992 to

² We use sampling weights in our multivariate regressions. Sampling weights are not necessary if the empirical specification represents the true model (Korn and Graubard, 1991). However, if the model is misspecified in any way, then weights are needed to ensure that parameter estimates reflect the relationship for the population. In the current analyses, we were unwilling to assume that our model is true in every respect, and thus made the conservative decision to use sampling weights in all analyses.

examine the comparability of our data over the two years. The first row of Table 1 presents the weighted mean of the log of hourly wages. We estimated hourly wages by dividing the self-reported labor income from all jobs in the past month by the hours worked at all jobs in the past month³. The average log wage for the combined sample is 2.664 for men and 2.322 for women. Mean log wages from the combined sample are similar to the means from the individual years.

Our core demographic variables included state indicator variables, race, age, education, metropolitan statistical area (MSA) population size, marital status, and health. The means for all of these variables, excluding the state indicators, are also shown in Table 1. Our combined sample is roughly 80% white, with a mean age of 40 years. Approximately 35% have 12 years of education, and roughly another 30% have graduated from college. Almost half of the sample lives in an MSA with more than a million residents, and nearly three-quarters are married. Finally, less than 10% of the sample reported being in fair to poor health. The demographic characteristics of our sample are fairly stable across both years of data with the point estimates for each individual year being within one standard deviation of the point estimate for the combined sample.

Following French and Zarkin (1995), we constructed an estimate of the total number of drinks consumed in the past 30 days by multiplying the typical number of drinks a respondent consumed per occasion by the number of times that respondent drank in the past 30 days. This variable ranged from 0 to 1800 drinks for men and from 0 to 900 drinks for women. Next, we used this drinking measure variable to create indicator variables for eight categories of alcohol use--one category for non-drinkers, two for light drinkers, three for moderate drinkers, and two for heavy drinkers. To define our categories, we first examined the distribution of the continuous drinking measure. Based on this distribution, we chose cut-off levels that were behaviorally meaningful to respondents (e.g., categories for less than one drink per week, for one drink per week up to one drink every other day) while at the same time ensuring sufficient data in each category.

³ French and Zarkin (1995) used weekly wages in their analysis, but the NHSDA data do not allow the calculation of weekly wages.

Table 1
Weighted means of analysis variables

	Men			Women		
	Combined (n = 5948)	1991 (n = 3015)	1992 (n = 2933)	Combined (n = 6177)	1991 (n = 3176)	1992 (n = 2991)
Wages (log)	2.664 (0.666)	2.654 (0.658)	2.674 (0.673)	2.322 (0.723)	2.307 (0.702)	2.338 (0.743)
<i>Race</i>						
White	0.797 (0.402)	0.800 (0.400)	0.795 (0.404)	0.789 (0.408)	0.791 (0.407)	0.788 (0.409)
Black	0.087 (0.282)	0.090 (0.287)	0.084 (0.277)	0.109 (0.311)	0.108 (0.310)	0.110 (0.313)
Hispanic	0.080 (0.272)	0.078 (0.269)	0.082 (0.275)	0.066 (0.248)	0.066 (0.248)	0.066 (0.248)
Other race	0.036 (0.185)	0.031 (0.174)	0.040 (0.195)	0.036 (0.187)	0.036 (0.186)	0.037 (0.188)
Age	40.499 (6.942)	40.235 (6.931)	40.748 (6.945)	40.585 (6.877)	40.383 (6.930)	40.786 (6.820)
<i>Education</i>						
No high school diploma (less than 12 years)	0.136 (0.343)	0.130 (0.337)	0.141 (0.348)	0.119 (0.324)	0.120 (0.325)	0.119 (0.323)
Graduated from high school, but did not attend college (12 years)	0.338 (0.473)	0.349 (0.477)	0.328 (0.470)	0.371 (0.483)	0.376 (0.484)	0.366 (0.482)
Attended college, but did not graduate (13 to 15 years)	0.208 (0.406)	0.207 (0.405)	0.209 (0.406)	0.239 (0.427)	0.235 (0.424)	0.244 (0.430)
College graduate (16 years or more)	0.318 (0.466)	0.313 (0.464)	0.323 (0.468)	0.270 (0.444)	0.270 (0.444)	0.271 (0.445)

<i>MSA population density</i>						
Greater than 1 million	0.458 (0.498)	0.453 (0.498)	0.464 (0.499)	0.431 (0.495)	0.424 (0.494)	0.439 (0.496)
250 000 to 1 million	0.245 (0.430)	0.255 (0.436)	0.237 (0.425)	0.263 (0.440)	0.280 (0.449)	0.246 (0.431)
Less than 250 000	0.079 (0.270)	0.073 (0.260)	0.085 (0.279)	0.070 (0.255)	0.073 (0.261)	0.066 (0.248)
Non-MSA urban area	0.068 (0.253)	0.062 (0.241)	0.075 (0.263)	0.061 (0.238)	0.053 (0.224)	0.068 (0.252)
Rural	0.149 (0.356)	0.158 (0.365)	0.140 (0.347)	0.175 (0.380)	0.169 (0.375)	0.181 (0.385)
Married	0.769 (0.422)	0.772 (0.420)	0.766 (0.424)	0.702 (0.457)	0.713 (0.453)	0.691 (0.462)
Fair or poor health in past year	0.068 (0.251)	0.055 (0.229)	0.080 (0.271)	0.069 (0.254)	0.072 (0.258)	0.067 (0.250)
<i>Number of drinks in the past 30 days for men [women]</i>						
0 [0]	0.337 (0.473)	0.329 (0.470)	0.343 (0.475)	0.483 (0.500)	0.457 (0.498)	0.509 (0.500)
<i>Light drinkers</i>						
1 to 5 [1 to 2]	0.166 (0.372)	0.177 (0.382)	0.156 (0.362)	0.146 (0.353)	0.159 (0.366)	0.133 (0.340)
6 to 16 [3 to 8]	0.188 (0.391)	0.186 (0.389)	0.190 (0.393)	0.174 (0.380)	0.183 (0.387)	0.166 (0.372)
<i>Moderate drinkers</i>						
17 to 31 [9 to 15]	0.129 (0.335)	0.117 (0.322)	0.139 (0.346)	0.072 (0.258)	0.065 (0.247)	0.078 (0.268)
32 to 62 [16 to 31]	0.114 (0.318)	0.117 (0.321)	0.112 (0.315)	0.077 (0.266)	0.087 (0.282)	0.067 (0.250)
63 to 93 [32 to 47]	0.027 (0.162)	0.028 (0.166)	0.025 (0.157)	0.014 (0.118)	0.013 (0.113)	0.015 (0.123)
<i>Heavy drinkers</i>						
94 to 124 [48 to 62]	0.017 (0.129)	0.021 (0.144)	0.013 (0.113)	0.018 (0.133)	0.018 (0.133)	0.018 (0.132)
125 or more [63 or more]	0.022 (0.148)	0.024 (0.152)	0.021 (0.145)	0.016 (0.126)	0.017 (0.130)	0.015 (0.122)

Standard deviations in parentheses.

For both men and women, we define non-drinkers as those respondents who did not drink alcohol in the past 30 days⁴. Because previous research (Ferrence, 1980; Wechsler et al., 1995; Mullahy and Sindelar, 1992; Parker and Harford, 1992; Robbins, 1991; Wilsnack and Wilsnack, 1991) suggests that men and women differ substantially in the amount of alcohol they consume and in the effects that any given amount of alcohol has on them, we defined the positive alcohol use categories differently for men and women. For men, we define the two light drinker categories as drinking 1 to 5 drinks in the past 30 days (i.e., up to 1 drink per week) and drinking 6 to 16 drinks in the past 30 days (i.e., from 1 drink per week up to 1 drink every other day). The three moderate drinker categories for men are 17 to 31 drinks (i.e., from 1 drink every other day up to 1 drink per day), 32 to 62 drinks (1 to 2 drinks per day), and 63 to 93 drinks (2 to 3 drinks per day) in the past 30 days. Finally, the two heavy drinker categories for men are 94 to 124 drinks (3 to 4 drinks per day) and 125 or more drinks (4 or more drinks per day) in the past 30 days.

Because the range of our continuous drinking variable for women is half that of men, we defined our drinking categories for women to represent approximately half the number of drinks as men. Thus, for women the two light drinker categories are 1 to 2 drinks in the past 30 days and 3 to 8 drinks in the past 30 days. The three moderate drinker categories for women are 9 to 15 drinks, 16 to 31 drinks, and 32 to 47 drinks in the past 30 days. Finally, the two heavy drinker categories for women are 48 to 62 drinks and 63 or more drinks in the past 30 days. While not a precise measure of the differential effects of alcohol on men and women, the lower cut-off levels for women are consistent with the literature (Ferrence, 1980; Wechsler et al., 1995; Parker and Harford, 1992; Robbins, 1991; Wilsnack and Wilsnack, 1991; Wilsnack et al., 1994; Lex, 1994; Caetano, 1994).

Table 1 reports the prevalence of each drinking category for men and women. In the combined sample, 34% of men and 48% of women consumed no alcohol in the past 30 days. Approximately 35% of men are light drinkers, while 32% of women are light drinkers. Moderate drinkers make up 27% of men and 16% of women; 4% of men and 3% of women are defined as heavy drinkers by our criteria. Overall, the prevalence of alcohol use is fairly stable across the 2 years of data. Most categories have prevalence differences of less than 1 percentage point, and the largest is a 2.6 percentage points difference in the prevalence of light drinking (1 to 2 drinks in the past month for women).

3. Empirical Method

Following French and Zarkin (1995), we estimate multivariate OLS models of the relationship between alcohol use and wages. Specifically, we estimate models of the form:

$$w = \beta_0 + \beta_1 \text{DEM} + \beta_2 \text{ALC} + e \quad (1)$$

⁴ In our empirical models, we tested whether there was a difference between non-drinkers who are former drinkers and those who never used alcohol. As in French and Zarkin (1995), this finer distinction within the non-drinking category did not change the coefficient estimates of the other drinking variables. Thus, we elected to use one non-drinker category in our specifications.

where w is the log of hourly wages and DEM is a vector containing the demographic variables shown in Table 1 plus age interacted with race, age squared, age squared interacted with race (see Mroz, 1987; Zarkin et al., 1996), and indicator variables for state and MSA size⁵. We include state and MSA size indicator variables to capture variations in labor market conditions and alcohol prices and policies that are not captured by other variables. The state indicator variables control for cross-state differences in the price of alcohol and any other variables that differ across states. The β s are coefficients, ALC is a vector of alcohol use variables, and e is an error term. In Section 4 we examine several estimation issues such as the appropriateness of OLS for estimating Eq. (1) and the implication of alternative definitions of our alcohol use variables.

French and Zarkin (1995) used a continuous measure of alcohol use reflecting the estimated number of drinks consumed in the past year. They estimated polynomial equations in this variable including linear, quadratic, and cubic specifications. French and Zarkin (1995) were concerned that outliers in their drinking variable may unduly influence the point estimates of their models. To address this issue, they use an estimation technique called bounded influence estimation. This estimation procedure was suggested by Welsch (1980) and is designed to minimize the influence of outliers. Based on their quadratic specifications, French and Zarkin (1995) concluded that an inverse-U-shaped relationship exists between log wages and alcohol consumption whereby moderate drinkers have *higher* wages than either light or heavy drinkers. French and Zarkin (1995) estimated that for prime-age workers, log wages reach a maximum at approximately 2.3 drinks per day (69 drinks per month).

As a starting point for our analyses, we estimated a quadratic specification similar to French and Zarkin's in which the alcohol use variables were measured by the estimated number of drinks consumed in the past 30 days⁶. In contrast to French and Zarkin (1995), neither the linear nor the quadratic terms were significantly different than zero, suggesting a constant relationship between alcohol use and wages. Furthermore, the point estimates suggested that drinkers had higher wages than non-drinkers, but that the wage premium declined at a slow rate (but was still positive) over 99% of the drinking distribution before turning up.

Although French and Zarkin (1995) used bounded influence estimation to handle outliers, we chose a different method that more directly reduces the influence of large values of reported alcohol use. Instead of using the continuous alcohol use variable, we created eight indicator variables as described above in which one category is for non-drinking and the other seven categories span the range of positive alcohol consumption. A distinct advantage of this approach is that very large drinking levels (e.g., 1800 drinks within the last 30 days, or 60 drinks per day) are included in the top category, 125 or more drinks for men (approximately 4 drinks per day) and 63 or more for women (approximately 2 drinks per day). Thus, the impact of very large and atypical drinking levels is greatly ameliorated. A disadvantage of this approach is that the estimated relationship between alcohol use and wages is the same for all drinking levels within a

⁵ We also estimated Eq. (1) with monthly indicator variables to examine the possibility that the wage-alcohol use relationship is affected by seasonal factors. Although the coefficients on these indicator variables are jointly significant, they had virtually no impact on our alcohol use coefficients.

⁶ We estimated these models using both OLS and the bounded influence procedure. Both estimation procedures gave essentially the same results. For comparison with French and Zarkin, the results discussed in the text are from the bounded influence models.

category (i.e., the estimated effect of alcohol use on wages is constant for a range of alcohol use, such as between 17 and 31 drinks in the past 30 days). We sought to minimize potential problems associated with estimating the effect of a range of alcohol use by choosing cells with a relatively narrow range and by creating cells with behaviorally meaningful and intuitive consumption levels.

We estimated models using three variations of the eight drinking indicators. First, we estimated models that included all seven of the positive drinking categories. Compared to using the continuous alcohol use measure with a quadratic or cubic specification, the seven indicator variables allow considerably more flexibility in the estimated alcohol use-wage relationship. Furthermore, the indicator variable approach provides considerable detail about the alcohol use-wage relationship at low levels of alcohol use, where the majority of respondents are distributed.

In the second variation, we collapsed the seven positive drinking categories into three categories consisting of a category for light drinkers (1 to 16 drinks in the past 30 days for men; 1 to 8 drinks for women), a category for moderate drinkers (17 to 93 drinks for men; 9 to 47 drinks for women), and a category for heavy drinkers (94 or more drinks for men; 48 or more drinks for women). In the third variation, we collapsed all of the positive drinking variables into a simple use/no use indicator to see if the alcohol use-wage relationship can be described by a simple shift in mean wages that is independent of the level of alcohol consumption.

4. Results

Table 2 presents OLS coefficient estimates with White/Huber standard errors using the combined 1991 and 1992 data for the three specifications discussed above. In all models, abstainers are the omitted category. Looking first at the seven-category model for men, the estimated wage differential between users and non-users of alcohol increases from a marginally significant 7% at 1 to 5 drinks in the past 30 days to a significant 9% with 6 to 16 drinks and 8% from 17 to 31 drinks. The remaining coefficients are positive but not significant. The F statistic tests for the joint significance of all the alcohol use coefficients and shows them to be jointly significant at the 0.07 level. Focusing on the statistically significant coefficients, the point estimates display an inverse U-shape over the range of 1 to 31 drinks in the last 30 days (i.e., up to one-half drinks per day) with a slight peak from 6 to 16 drinks.

Turning to the seven category results for women, we see that four of the seven coefficients are positive, but only one is significant. The alcohol use coefficients are not jointly significant.

Table 2 also reports the test of the joint equality of all seven coefficients. We do not reject equality for either men or women, suggesting that we may be able to combine alcohol use categories. We tested the null hypothesis that we could collapse the seven categories into three by combining the first two drinking levels into a light drinking variable, the middle three drinking levels into a moderate drinking variable, and the last two drinking levels into a heavy drinking variable (abstainers remain a separate group and are the omitted category). The F statistic for this test is reported in Table 2 and shows that we do not reject the implied coefficient restrictions for either men or women.

Table 2
Selected wage equation (OLS) coefficients for the combined 1991 and 1992 data^a

	Men	Women
<i>Model I</i>		
Number of drinks in past 30 days for men [women]		
1 to 5 [1 to 2]	0.068 * (0.041)	-0.003 (0.037)
6 to 16 [3 to 8]	0.093 * * (0.033)	0.086 * * (0.038)
17 to 31 [9 to 15]	0.076 * * (0.032)	0.034 (0.063)
32 to 62 [16 to 31]	0.022 (0.039)	0.047 (0.054)
63 to 93 [32 to 47]	0.012 (0.049)	0.073 (0.071)
94 to 124 [48 to 62]	0.090 (0.078)	-0.002 (0.118)
125 or more [63 or more]	0.075 (0.086)	-0.042 (0.111)
<i>Model II</i>		
Light drinkers	0.081 * * * (0.031)	0.046 (0.032)
Moderate drinkers	0.046 * (0.027)	0.044 (0.041)
Heavy drinkers	0.082 (0.053)	-0.021 (0.081)
<i>Model III</i>		
Any alcohol use in past 30 days	0.067 * * * (0.025)	0.040 (0.029)
<i>Model I tests</i>		
<i>F</i> for joint significance of the seven alcohol use variables	1.870	1.250
<i>P</i> value	0.070	0.269
<i>F</i> for equality of seven alcohol use variables	1.120	1.250
<i>P</i> value	0.346	0.278
<i>F</i> for collapsing the seven alcohol use categories into three categories	1.020	1.340
<i>P</i> value	0.396	0.253
<i>Model II tests</i>		
<i>F</i> for joint significance of light, moderate, and heavy categories	2.470	0.840
<i>P</i> value	0.060	0.473
<i>F</i> for equality of light, moderate, and heavy categories	0.710	0.340
<i>P</i> value	0.493	0.713

* Significant at the 0.10 level.

* * Significant at the 0.05 level.

* * * Significant at the 0.01 level.

Standard errors in parentheses.

^aThese wage regressions also include race, age, race×age interactions, education, MSA size, marital status, and a health indicator. The complete results are available from the first author.

Looking at the three-category model estimation results for men (Model U), we see that all three coefficients are positive and two are significant. The *F* statistic that tests for the joint significance of the three drinking categories shows them to be jointly significant for men at the 0.06 level.

For women, we see that two of the three coefficients are positive, and none are significant. The test for joint significance shows that the three drinking categories are jointly insignificant for women. Table 2 also reports the F statistic for the hypothesis that the three category coefficients are equal. We do not reject the null hypothesis for men or women, suggesting that a simple use/no use indicator may be the preferred specification to capture the alcohol use effect.

Finally, we collapsed our drinking categories into a simple use/no use indicator. Estimation results indicate that, for men, alcohol consumption is associated with a positive wage differential of about 7%, an effect that is significant at the 0.01 level. For women, alcohol consumption is associated with a wage differential of approximately 4%. This differential, however, is only significant at the 0.17 level.

4.1 Specification Issues

In this section we address three estimation issues that bear on our results. First, we discuss the issue of the stability of the estimated parameters between 1991 and 1992. Second, we consider the possibility that alcohol use may be endogenous to the wage equation. Finally, we examine the possibility that our results may be driven by our choice of drinking categories. All results discussed in this section are available from the corresponding author upon request.

A possible concern with estimating our model on the combined 1991 and 1992 data is that the relationship between wages and alcohol use may not be stable across time. Zarkin et al. (1996) use the 1991 and 1992 NHSDA to estimate the relationship between hours of work and drug use for young men. Their results suggest that the relationship between drug use and hours of work may not be stable across time, even across a period as short as 1 year. To address these concerns, we estimated our models separately for each year and tested the null hypothesis that the alcohol use coefficients were equal across the years. In every model we did not reject the null hypothesis that the coefficients were equal. Based on these results, we estimated the models reported in Table 2 using the combined 1991 and 1992 data. In all models we constrained the alcohol use variables to have the same coefficients in both years, but allowed the coefficients on all other explanatory variables to vary across the 2 years.

Although test results support our decision to combine the 1991 and 1992 data, it is worthwhile to summarize the separate 1991 and 1992 results. For men, these models show a significant wage differential of about 9% in 1991 and an insignificant wage differential of about 5% in 1992. For women, we found a marginally significant wage differential of about 8% in 1991 and an insignificant wage differential of less than 1% in 1992. In general, the 1992 data show smaller but less significant wage differentials associated with any given drinking level than the 1991 data⁷.

⁷ In a previous paper, Zarkin et al. (1996) found significant year-to-year variation in the estimated relationship between light marijuana use and hours worked. Although we focus on alcohol use here, we have some concern about the stability of models that examine the relationship between drug or alcohol use and labor market outcomes such as hours of work and wages. We did find some year-to-year differences in the estimated alcohol use-wage relationship, but the differences were much less pronounced than in Zarkin et al. (1996).

Another concern is the potential endogeneity of alcohol use. If unobserved factors influence both the wage rate and the decision to drink alcohol, then alcohol use will be correlated with the error term in Eq. (1). French and Zarkin (1995) mention the possibility that alcohol use may be endogenous, but they lacked adequate instrumental variables to statistically address the issue.

To address the possibility of endogeneity, we estimated models in which the alcohol use variables are predicted by instrumental variables. Although the NHSDA are an excellent source of data on drug and alcohol prevalence, they contain relatively few variables that can be used to explain the decision to use alcohol. We chose variables that reflect respondents' assessments of risk associated with using various substances (e.g., the risk associated with drinking five or more drinks on one occasion) as instruments in estimating two-stage least squares (2SLS) models.

Although we estimated several 2SLS models, we report OLS results over the 2SLS results for several reasons. First, the point estimates of the 2SLS coefficients on the seven alcohol use indicator variables suggested wage differentials on the order of 50% to 200%. We felt that these estimates were implausibly large. Second, the 2SLS estimates were very imprecise, with standard errors that ranged from 1.5 to 2 times the size of the point estimates. Finally, using a test for the overidentification of the instruments described in Zarkin et al. (1996), we rejected the null hypothesis of overidentification. This result suggests that our instruments may not be validly excluded from the wage equation. To ensure that our estimated alcohol use indicators were not capturing the effect of the excluded instrumental variables, we re-estimated an augmented wage equation that included our instruments. We found that the alcohol use coefficients were essentially unchanged from the OLS specification⁸.

A final concern is that our results are driven by the definition of our seven positive drinking categories. Our definitions of light, moderate, and heavy drinkers are somewhat arbitrary definitions based on cut-offs that we thought were intuitive. Possibly, our results would be different if we chose alternative definitions for the alcohol use indicator variables. To examine this possibility, we created a separate indicator variable for every value of our continuous drinking variable and estimated the wage equation using these indicator variables (for men there were 117 separate drinking responses and for women there were 78 responses). This specification is a fully non-parametric representation of the alcohol use-wage relationship. The coefficients from this specification represent the wage differential associated with each separate drinking level.

To smooth the variability of the individual coefficients, we weighted each coefficient estimate by the inverse of its standard error and calculated a *moving average* over the series. This *smoothing procedure* puts less weight on imprecisely estimated coefficients. We then graphed the smoothed series against our continuous drinking variable. An examination of this graph showed that the average wage differential was approximately 7% for men and 4% for women, which are the coefficient estimates on the use/no use indicators of our most restricted models. Thus, we

⁸ Another concern is the possibility of sample selection bias. Our point estimates of the effects of alcohol use may be biased because we limited our sample to workers. To address this issue, we estimated wage models that included the inverse Mills ratio from a first-stage probit on the decision to work (see Heckman, 1979). Our probit equation included all of the demographic variables included in our wage equation plus the risk variables used as instruments in the 2SLS models mentioned above. We found that for both men and women, the inverse Mills ratio was insignificant and the alcohol use coefficients were not substantially affected.

conclude that our cut-offs for the drinking level indicators did not adversely affect either our seven-indicator or our three-indicator models.

5. Summary and conclusion

In this paper, we evaluated whether the inverse-U-shaped relationship between wages and alcohol use found by French and Zarkin (1995) using four worksites could be replicated on a national sample of individuals from the 1991 and 1992 National Household Surveys of Drug Abuse. In addition, we relaxed the functional form restrictions of French and Zarkin (1995) and estimated separate models for men and women. Whereas French and Zarkin (1995) found that wages for individuals who drink approximately 1.5 to 2.5 drinks per day are larger than for non-drinkers and heavy drinkers, our results suggest that men who use alcohol have approximately 7% higher wages than men who do not drink, and this estimated wage premium is approximately the same over a wide range of alcohol consumption. For women, the estimated alcohol use premium is approximately half as large as for men and is only significant at the 0.17 level.

Although strong evidence suggests that *alcoholism* is negatively associated with wages (Mullahy and Sindelar, 1991, 1992, 1993, 1996), overall, we found no evidence that alcohol *use* is associated with lower wages even at high levels of use. Subject to the qualifications we have noted, our results suggest that male alcohol users have *higher* wages than non-users. As we noted in French and Zarkin (1995), the emphasis on policing and monitoring alcohol use per se may be misplaced. Perhaps policymakers and employers should pay more attention to identifying negative consequences associated with alcohol abuse (such as workplace performance problems and absenteeism) rather than focusing only on quantity and frequency measures of use.

Acknowledgements

This research was supported by a grant from the National Institute on Drug Abuse, DA07821-02.

References

- Benham, L., Benham, A., 1992. Employment, earnings, and psychiatric diagnosis. In: Fuchs, V. (Ed.), *Economic Aspects of Health*, University of Chicago Press, Chicago.
- Berger, M.C., Leigh, J.P., 1988. The effect of alcohol use on wages. *Appl. Econ.* 20, 1343-1351.
- Boffetta, P., Garfinkel, L., 1990. Alcohol drinking and mortality among men enrolled in an American Cancer Society prospective study., *Epidemiology* 1, 342-348.
- Caetano, R., 1994. Drinking and alcohol-related problems among minority women. *Alcohol Health Res. World* 18 (3), 233-242.
- Doll, R., Peto, R., Hall, E., Wheatley, K., Gray, R., 1994. Mortality in relation to consumption of alcohol: 13 years' observations on male British doctors. *Br. Med. J.* 309, 911-918.
- Ferrence, R.G., 1980. Sex differences in the prevalence of problem drinking. In: Kalant, D.N. (Ed.), *Alcohol and Drug Problems in Women: Research Advances in Alcohol and Drug Problems*, Vol 5, Plenum, New York, pp. 69-124.

- French, M.T., Zarkin, G.A., 1995. Is moderate alcohol use related to wages? Evidence from four worksites. *J. Health Econ.* 14, 319-344.
- Heckman, J., 1979. Sample selection bias as a specification error. *Econometrica* 47, 153-161.
- Heien, D.M., 1996. Do drinkers earn less?. *Southern Econ. J.* 63, 60.
- Hoyt, G.M., Chaloupka, F.J., 1994. Effect of survey conditions on self-reported substance use. *Contemporary Econ. Policy* 12, 109-121.
- Huber, P.J., 1967. The behavior of maximum likelihood estimates under non-standard conditions. *Proc. Fifth Berkeley Symp. Math. Stat. Probability* 1, 221-233.
- Kenkel, D.S., Ribar, D.C., 1994. Alcohol consumption and young adults' socioeconomic status. *Brookings Papers on Economic Activity: Microeconomics*, pp. 119-161.
- Korn, E.L., Graubard, B.I., 1991. Epidemiologic studies utilizing surveys: accounting for the sampling design. *Am. J. Public Health* 81, 1166-1173.
- Lex, B.W., 1994. Alcohol and other drug abuse among women. *Alcohol Health Res. World* 18 (3), 212-219.
- Mroz, T.A., 1987. The sensitivity of an empirical model of married women's hours of work to economic and statistical assumptions. *Econometrica* 55 (4), 765-799.
- Mullahy, J., Sindelar, J.L., 1991. Gender differences in labor market effects of alcoholism. In: *American Economic Association Papers and Proceedings*, May, 161-165.
- Mullahy, J., Sindelar, J.L., 1992. Effects of alcohol on labor market success: income, earnings, labor supply, and occupation. *Alcohol Health Res. World* 16 (2), 134-139.
- Mullahy, J., Sindelar, J.L., 1993. Alcoholism, work, and income. *J. Labor Econ.* II (3), 494-520.
- Mullahy, J., Sindelar, J.L., 1996. Employment, unemployment, and problem drinking. *J. Health Econ.* 15, 409-434.
- Parker, D.A., Harford, T.C., 1992. Gender-role attitudes, job competition and alcohol consumption among women and men. *Alcoholism: Clin. Exp. Res.* 16 (2), 159-165.
- Robbins, C.A., 1991. Social roles and alcohol abuse among older men and women. *Family Community Health* 13 (4), 37-48.
- Substance Abuse and Mental Health Services Administration (SAMHSA), 1992. *National Household Survey on Drug Abuse: Public Release Codebook 1991*, U.S. Department of Health and Human Services, Rockville, MD.
- Substance Abuse and Mental Health Services Administration (SAMHSA), 1994. *National Household Survey on Drug Abuse: Public Release Codebook 1992*, U.S. Department of Health and Human Services, Rockville, MD.
- Substance Abuse and Mental Health Services Administration (SAMHSA), 1995. *Preliminary Estimates from the 1994 National Household Survey on Drug Abuse*, U.S. Department of Health and Human Services, Rockville, MD.
- StataCorp, 1995. *Stata Statistical Software: Release 4.0*, Stata, College Station, TX.
- Turner, C., Lessler J., Devore, J., 1992. Effects of mode of administration and wording on reporting of drug use. In: *Survey Measurement of Drug Use: Methodological Studies*, National Institute on Drug Abuse, Rockville, MD.
- Wechsler, H., Dowdall, G.W., Davenport, A., Rimm, E.B., 1995. A gender specific measure of binge drinking among college students. *Am. J. Public Health* 85 (7), 982-985.
- Welsch, R.E., 1980. Regression sensitivity analysis and bounded-influence estimation. In: *Evaluation of Econometric Models*, Academic Press, pp. 153-167.

- White, H., 1980. A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica* 48, 817-830.
- Wilsnack, S.C., Wilsnack, R.W., 1991. Epidemiology of women's drinking. *J. Substance Abuse* 3, 133-157.
- Wilsnack, R.W., Wilsnack, S.C., 1992. Women, work, and alcohol: failures of simple theories. *Alcoholism: Clin. Exp. Res.* 16 (2), 172-179.
- Wilsnack, R.W., Wilsnack, S.C., Klassen, A.D., 1984. Women's drinking and drinking problems: patterns from a 1981 national survey. *Am. J. Public Health* 74 (11), 1231-1238.
- Wilsnack, S.C., Wilsnack, R.W., Hiller-Sturmhofel, S., 1994. How women drink: epidemiology of women's drinking and problem drinking. *Alcohol Health Res. World* 18 (3), 173-184.
- Zarkin, G.A., Mroz, T.A., Bray, J.W., French, M.T., 1996. The relationship between drug use and labor supply for young men, RTI Working Paper.